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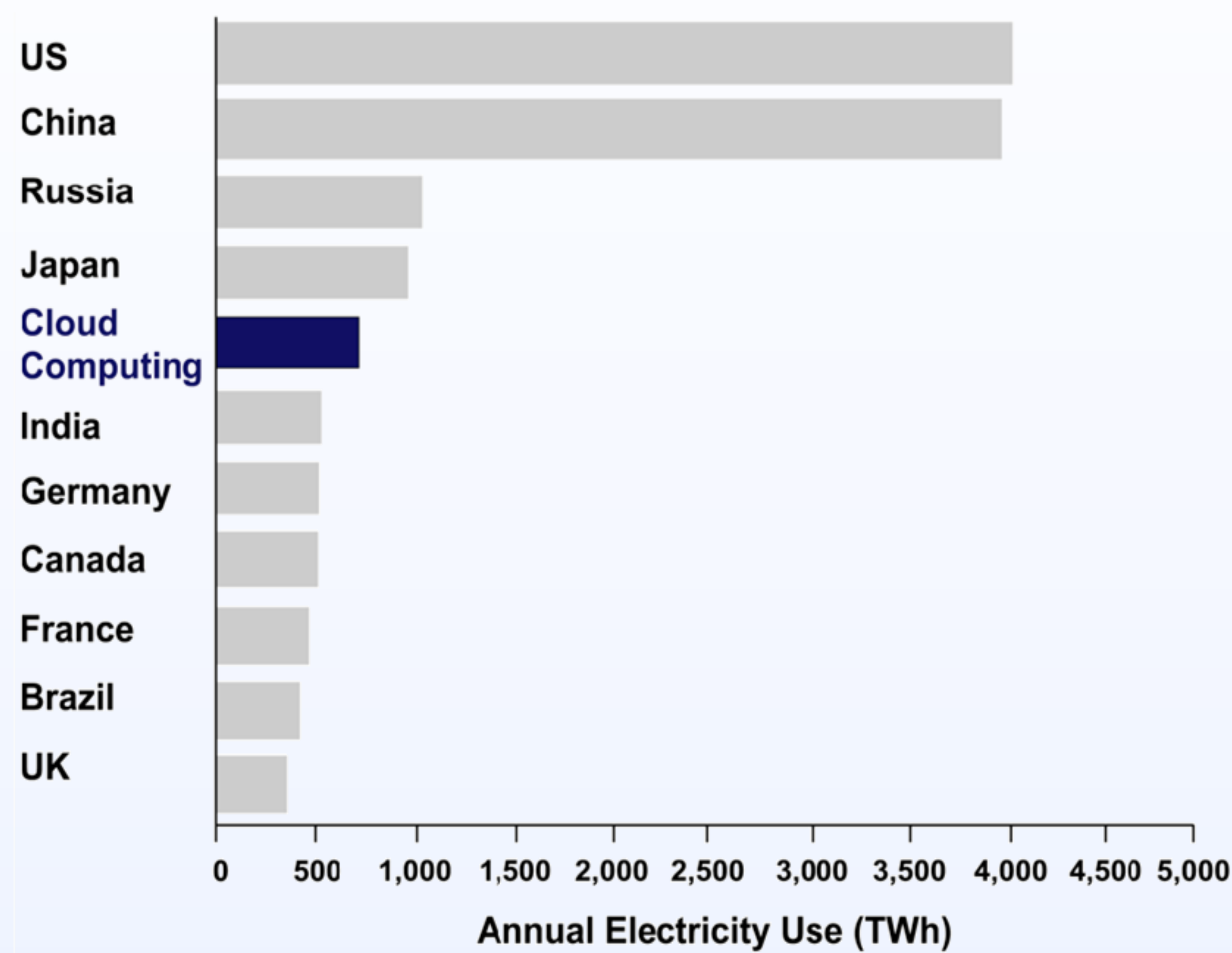
# Energy Efficiency in Cloud Software Architectures



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## Is Cloud Computing really energy-efficient?

### Global Cloud Electricity Consumption



Source: Greenpeace International, How Clean is Your Cloud, April 2012

**Motivation:** Global ICT energy consumption constantly grows. Cloud computing is assumed to be energy-efficient, hence leading to a steady growth of cloud-based software services.

**Goal:** investigate Cloud-based software to understand how its software architectures deal with energy-efficiency.

**Research methods:** Systematic Literature Review

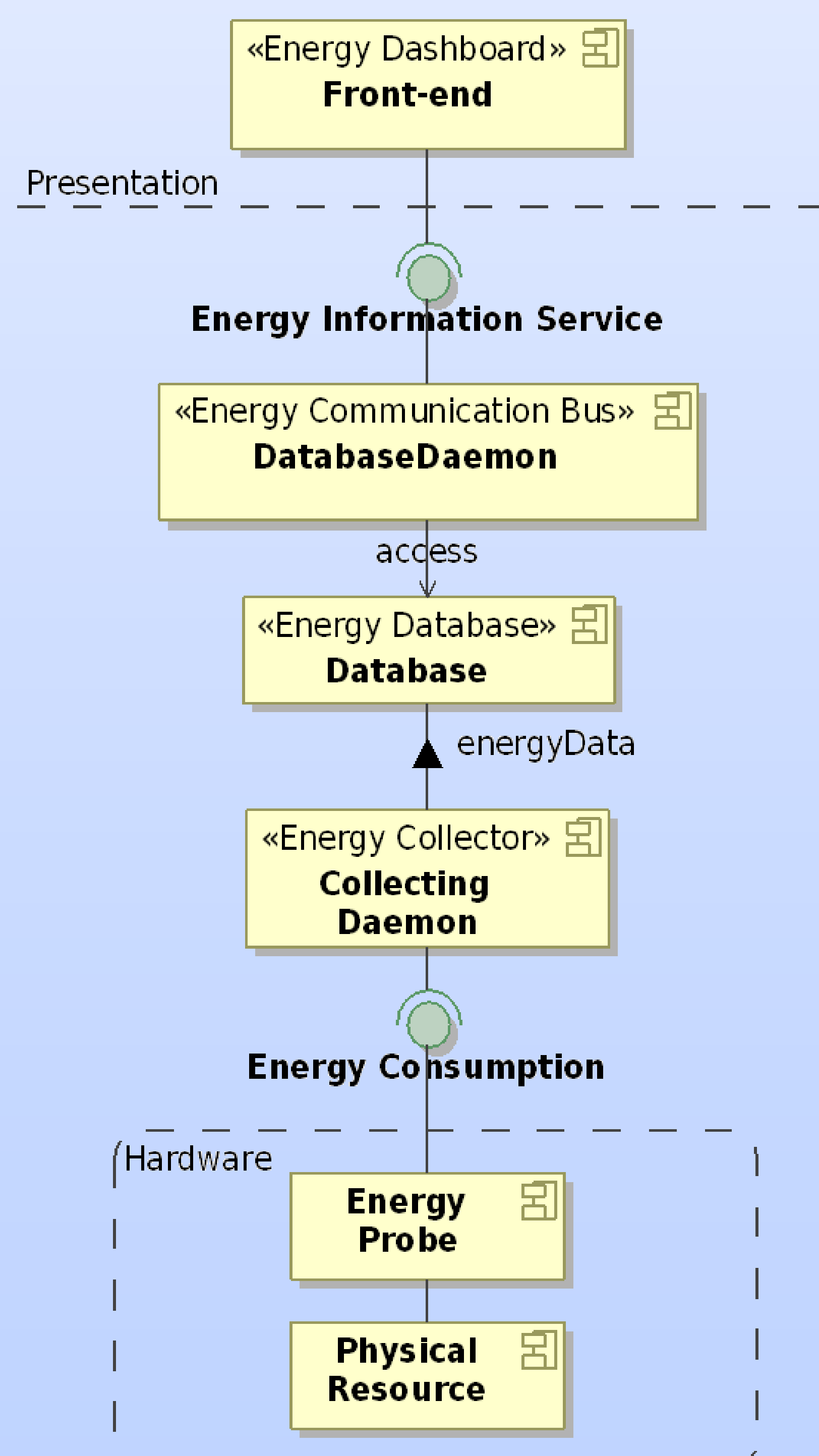
**Results:** software architectural strategies addressing energy efficiency aspects of Cloud-based software services.

## Software Architectural Strategies for Energy Efficiency

We identified the following software architectural strategies to guide the design of energy-efficient software.

### Energy Monitoring

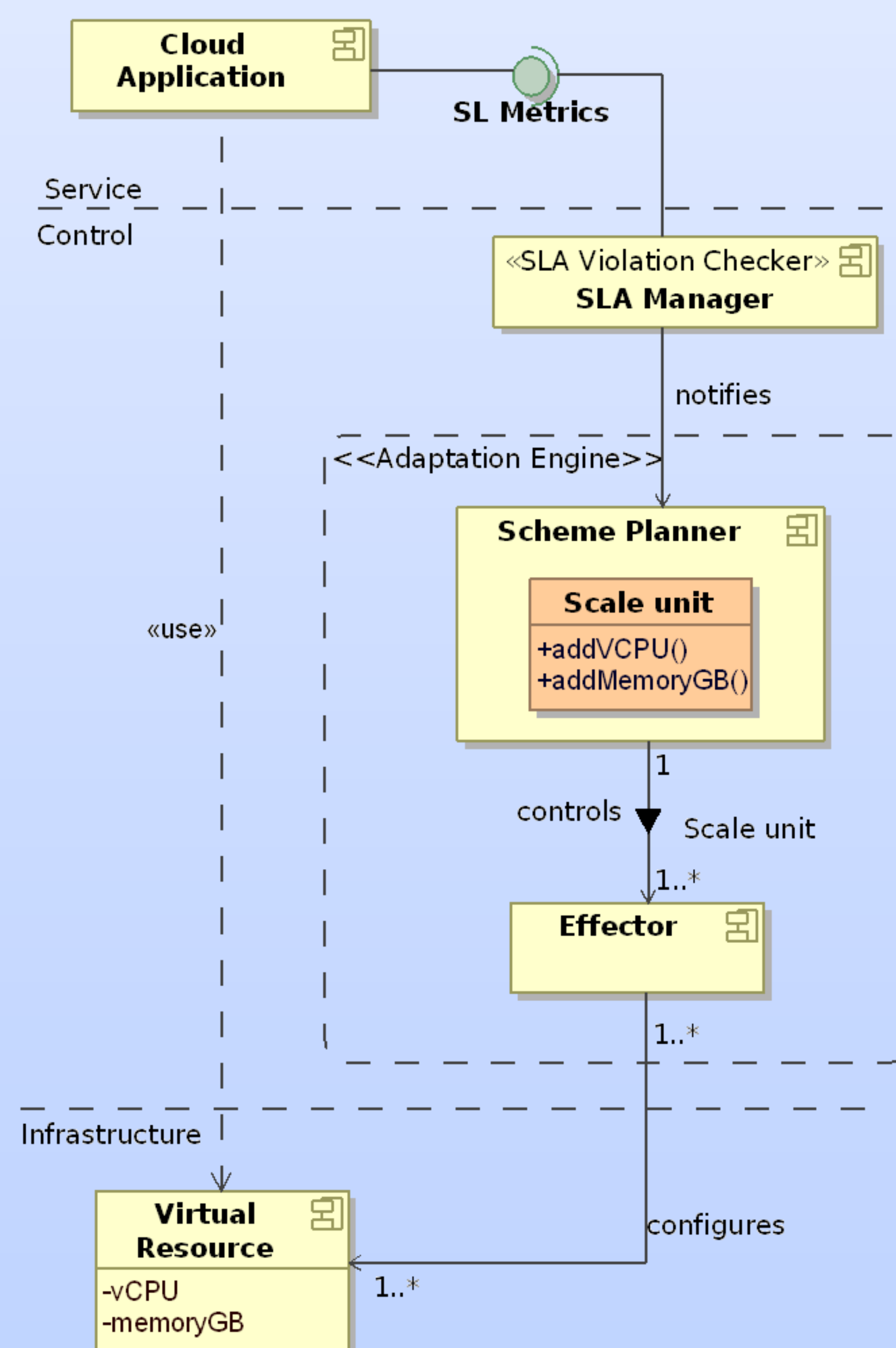
Monitor the energy consumption of the cloud infrastructure.



Example: Energy metering

### Self-Adaptation

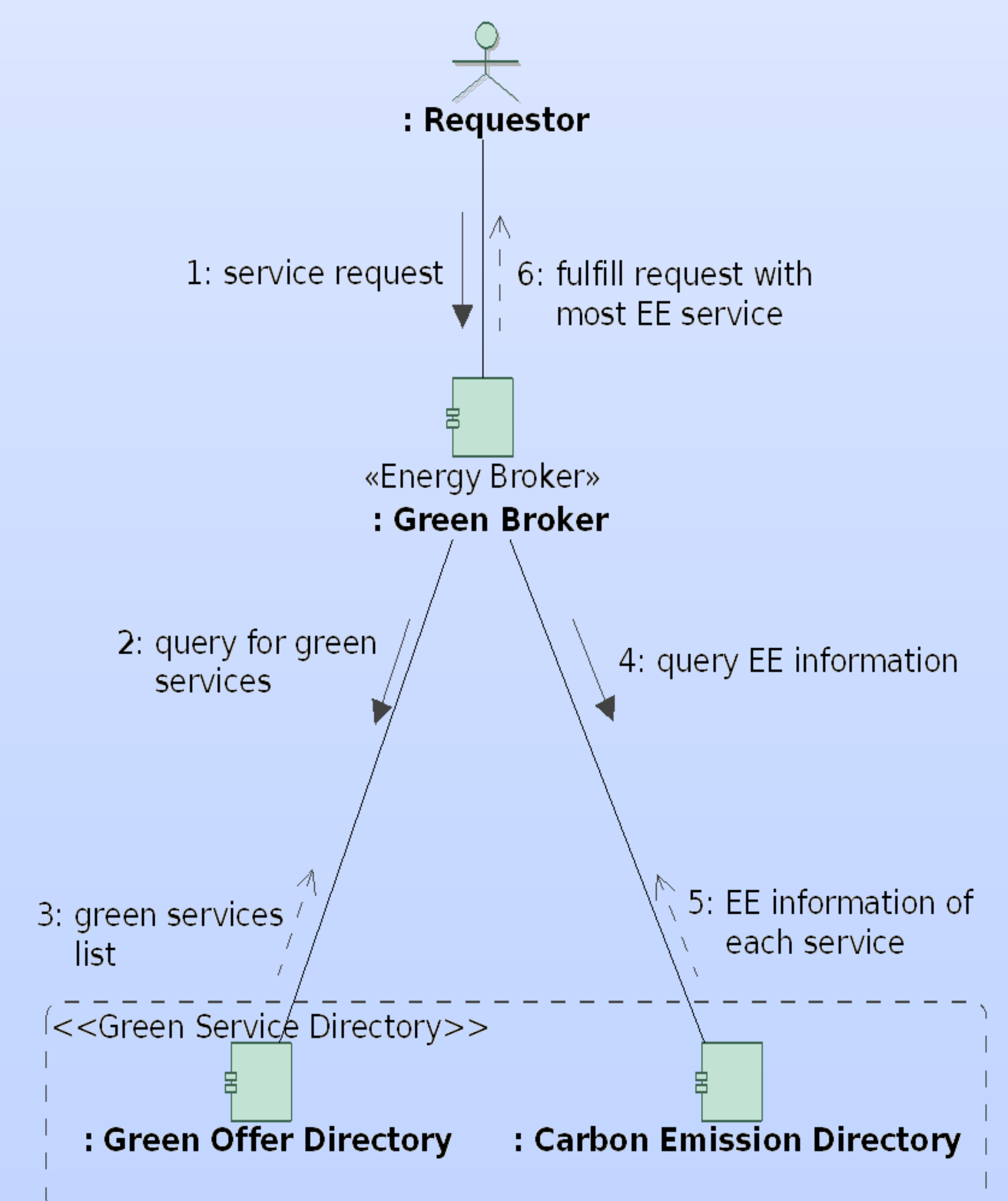
Reconfigure software at runtime to lower energy consumption.



Example: VM Scaling

### Cloud Federation

Negotiate cloud services from multiple providers by using energy consumption information.



Example: Energy Broker

## References

Procaccianti G., Bevini S., Lago P. **Energy Efficiency in Cloud Software Architectures**. In: 27th International Conference on Informatics for Environmental Protection (EnvirolInfo), Hamburg, Germany, September, 2013.

Procaccianti G., Lago P., Lewis G.A. **Green Architectural Tactics for the Cloud**. Submitted to: The 11th Working IEEE/IFIP Conference on Software Architecture (WICSA), Sydney, Australia, April, 2014.



Giuseppe Procaccianti is a double-degree PhD candidate of the VU University Amsterdam and Politecnico di Torino. He works in the Software & Services research group. His main research interest is energy-efficient software.